TITLE OF THE INVENTION

SUBSCRIBER WIRELESS ACCESS SYSTEM

BACKGROUND OF THE INVENTION

Field of the Invention:

This invention relates to a subscriber wireless access system for accommodating in a customer station wirelessly connected to a base station, personal computers and other such communication terminal devices, or a LAN connected to such communication terminal devices. (A subscriber wireless access system of this type is also called, for example, a fixed wireless access (FWA) system.) More particularly, the present invention relates to a technology for controlling communications through a virtual dedicated line network implemented by an ATM (asynchronous transfer mode) network or the like.

Description of the Prior Art:

Recent years have seen personal computers, mobile tools, mobile telephones and various other kinds of communication terminal equipment become common items of everyday use. Wireless LANs for wirelessly interconnecting such communications terminal devices have been developed and put into operation.

There have also been developed and implemented subscriber wireless access systems that accommodate in a customer station communication terminal devices, or a LAN or the like connected to communication terminal devices, and that wirelessly connect the customer station with a base station.

The wireless communication capability such a subscriber wireless access system provides between the base station and the customer stations makes it possible to interconnect the communications network on the base station side and the communication terminal devices on the customer station side. By allowing the base station to function as a bridge, moreover, such a system can provide interconnection among the communication terminal devices of multiple customer stations accommodated by one and the same base station.

Use of a subscriber wireless access system therefore makes it possible, by simply setting up a base station and a customer station, to connect communication terminal devices, or their LANs, to a communications network without need for installing communication lines.

Use of a subscriber wireless access system also makes it possible to group a number of customer stations served by the same base station. For example, a subscriber's LANs can be divided up and each connected to a different customer station within the same group. A company (subscriber) with several buildings can connect the LANs installed in the individual buildings to different customer stations within the same group and thus enjoy such benefits as companywide LAN integration.

The rising importance of and need for telecommunications are producing strong demand for constant interconnection between communication terminal devices. Demand for constant connection is also strong from users of subscriber wireless systems, who are seeking to use ATM network and other virtual dedicated line network services offered by communications companies to maintain constant connection among the communication terminal devices under their customer stations.

The subscriber wireless access system, which uses a virtual dedicated line network to interconnect different base stations, enables the communication terminal devices served by the different customer stations wirelessly connected to these different base stations to maintain constant connection via the virtual dedicated line network.

In the subscriber wireless access system, however, since the base stations accommodate multiple customer stations belonging to different entities, mere connection of base stations by a virtual dedicated line network results in constant connection between customer stations that should not be constantly connected (i.e., between their communication terminal devices).

Consider, for example, the case where company A's head office in Tokyo has a customer station served by a base station in Tokyo and its branch office in Osaka has a customer station served by a base station in Osaka. If the LAN of the Tokyo head office customer station and the LAN of the Osaka branch office customer station are constantly connected, the LAN of company B's customer station accommodated by the same base station as company A's Tokyo head office customer station will also be constantly connected with company A's Osaka branch office. This is undesirable from the point of secrecy protection.

This invention was accomplished in light of these circumstances and has as an object to provide a subscriber wireless access system that enables trouble-free constant connection through a virtual dedicated line network.

Other objects of the present invention will become apparent from the following description.

SUMMARY OF THE INVENTION

The present invention provides a subscriber wireless access system equipped with customer stations wirelessly connected to base stations and accommodating communication terminal devices in the customer stations directly or through a network such as a LAN. The subscriber wireless access system according to the present invention comprises: at least one exchange for connecting base stations with a virtual dedicated line network for enabling customer stations wirelessly connected to different base stations to be interconnected via a virtual dedicated line network, the exchange including a table correlating identification information assigned to the customer stations with virtual dedicated line network connection information allocated for connecting the customer stations; means responsive to receipt of

data from a customer station via a subordinate base station for, with reference to the table, sending the data through the virtual dedicated line network to another base station; and means responsive to receipt of data through the virtual dedicated line network for, with reference to the table, converting the data to customer station identification information of a customer station and sending the data to a subordinate base station.

For example, in a specific configuration, the exchange stores in the table station-specific IDs (CPE-IDs: consumer premises equipment identifiers) assigned to the individual customer stations or tags (VLAN-Tags: virtual local area network tags) for customer station identification set in Ethernet frames in conformity with IEEE 802.1Q in association with virtual dedicated line network connection information (VPI/VCI: virtual path identifier/virtual channel identifier), responds to receipt of data form a customer station via a subordinate base station by, with reference to the table, converting identification information of the sending customer station attached to the data (CPE-ID or VLAN-Tag) to virtual dedicated line network connection information (VPI/VCI) and sending the data to another base station through the virtual dedicated line network, and responds to receipt of data through the virtual dedicated line network by, with reference to the table, converting the virtual dedicated line network connection information (VPI/VCI) of the data to customer station identification information (CPE-ID or VLAN-Tag) and sending the data to a subordinate base station (i.e., a customer station).

Constant connection between customer stations (namely, their subordinate communication terminal devices) can therefore be realized. Since the subscriber wireless access system can establish constant connection between specific subscribers, moreover, it makes possible services like distribution of information from a pay TV station to subscribers.

In the subscriber wireless access system according to the present invention, an exchange is preferably connected to every base station or incorporated in every base station to control communications between the base station and the virtual dedicated line network. Preferably, the tables of the exchanges store identical virtual dedicated line network connection information (VPI/VCI) for customer stations connected through the virtual dedicated line network.

For instance, the connection information associated with the identification information of customer station A stored in one exchange table and the connection information associated with the identification information of a customer station B stored in another exchange connected to the same virtual dedicated line network are identical. Thus, for example, the customer station of a company's Tokyo head office and the customer station of the same company's Osaka branch office can maintain constant connection in a closed environment, whereby the communication terminal devices served by the two customer stations can stay in constant connection while maintaining communication privacy.

In the subscriber wireless access system of the present invention, each customer station is preferably assigned station-specific identification information for identifying the

individual customer station and group identification information for identifying it as a member of a customer station group and each base station has tables correlating the station-specific identifier information and the group identification information and stores the same group identification information (VLAN-Tag) for customer stations belonging to the same group.

For example, in a specific configuration, the station-specific identifier information of each customer station is a CPE-ID and the group identification information is a VLAN-Tag, the base stations correlate and manage the CPE-IDs and the VLAN-Tags using the tables, and the same VLAN-Tag is stored for customer stations belonging to the same group. For instance, in a case where five customer stations whose CPE-IDs are A to E are installed under a certain base station and the two customer stations whose CPE-IDs are B and D are to be grouped, they are managed by assigning them the same VLAN-Tag in the table.

Therefore, since the group identification information (VLAN-Tags) of the base stations and the customer stations are included in the wireless frames and the base stations conduct communications control using the VLAN-Tags, different customer stations under the base stations can be formed into closed groups, the communication terminal devices under each group of customer stations can be virtually connected as if connected to the same LAN.

Further, if the VLAN-Tags constituting the identification information of the customer stations are managed by associating them with the virtual dedicated line network connection information (VPI/VCI) also in the exchange table, customer station groups under different base stations can also be constantly connected through the virtual dedicated line network.

The subscriber wireless access system can be configured as a simple network management protocol (SNMP) system, the tables of the base stations be configured as management information bases (MIBs), and the group identification information (VLAN-Tags) be written to the management information bases using information sent from a management unit (SNMP manager) connected via the virtual dedicated line network.

This makes it possible, for example, for an administration (operation) center that has received a subscriber request for group formation to establish the desired group by remote operations with respect to the base stations. Groups of customer stations constantly connected through the virtual dedicated line network can therefore be easily established without need for workers to visit and conduct on-site setup at the individual base stations.

In the subscriber wireless access system according to the present invention, the group identification information (VLAN-Tags) assigned to the customer stations are preferably included in the wireless frames of the base stations and the customer stations and, therefore, as explained in the foregoing, the communication terminal devices under multiple customer stations can be virtually connected as if connected to the same LAN and, in addition, the subordinate customer stations can be notified of the group identification information (VLAN-Tags) written in the base station tables.

The present invention also provides an exchange for connecting base stations to a virtual dedicated line network to enable customer stations wirelessly connected with different base stations to be interconnected via the virtual dedicated line network, the exchange comprising: a table correlating identification information assigned to the customer stations (VLAN-tags, CPE-IDs or the like) with virtual dedicated line network connection information allocated for connecting the customer stations (VPI/VCI or the like); means for, with reference to the table, sending data received from a customer station via a subordinate base station through the virtual dedicated line network to another base station; and means for, with reference to the table, converting data received through the virtual dedicated line network to customer station identification information and sending the data to a subordinate base station

The present invention also provides a base station capable of connecting to a virtual dedicated line network for enabling customer stations wirelessly connected with different base stations to be interconnected via the virtual dedicated line network, the base station comprising: a table correlating identification information assigned to the customer stations (VLAN-tags, CPE-IDs or the like) with virtual dedicated line network connection information allocated for connecting the customer stations (VPI/VCI or the like); means for, with reference to the table, sending data received from a customer station via a subordinate base station through the virtual dedicated line network to another base station; and means for, with reference to the table, converting data received through the virtual dedicated line network to customer station identification information and sending the data to a subordinate base station.

BRIEF EXPLANATION OF THE DRAWINGS

FIG. 1 is a block diagram of a subscriber wireless access system that is an embodiment of the present invention.

FIG. 2 is a conceptual diagram for explaining the contents of tables of a subscriber wireless access system that is an embodiment of the present invention.

FIG. 3 is a conceptual diagram for explaining an Ethernet frame in an embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention will now be explicitly explained with respect to the case where the communication protocol between the base station and the customer stations utilizes Ethernet frames tagged with VLAN-Tags conforming with IEEE 802.1Q.

FIG. 1 is a block diagram of the subscriber wireless access system according to the present embodiment. FIG. 2 is a diagram showing the contents of correlation tables of the exchanges and base stations.

As shown in FIG. 1, multiple base stations are connected by SNMP via an ATM trunk network N, which is a virtual dedicated line network. Each base station accommodates a number of customer stations wirelessly connected by Ethernet frames. Each customer station is connected through a router R with a local area network L accommodating a large number of communication terminal devices (PCs; not shown).

The ATM trunk network N is connected with various servers of Internet service providers (ISP-A, ISP-B) and the like. It is also connected with a SNMP manager server M installed at an operation center that manages the subscriber wireless access system according to the present invention.

In the ensuing explanation, the two base stations are designated base station #1 and base station #2, the four customer stations accommodated by base station #1 are designated CPE#1 – CPE#4, and the four customer stations accommodated by base station #2 are designated CPE#5 – CPE#8.

In this embodiment, an exchange is incorporated in the ATM trunk network interface unit of each base station. The exchange section of each, which mainly handles communications control of the virtual dedicated line network, is designated ATM-SW, and the base station section of each, which mainly handles wireless communications control of the customer stations, is designated BSE.

In each of the base station #1 and the base station #2, the ATM-SW is provided with a MIB table T1 and the BSE is provided with a MIB table T2. The contents of the MIB tables can be defined by the SNP server through the ATM trunk network N.

In this embodiment, the MIB tables T1 and T2 are defined to store contents like those shown in FIG. 2.

In the table T2 provided in the BSE of the base station #1, the station-specific identifier CPE-IDs of the of the subordinate CPEs #1 – #4 are entered in association with the group identifiers VLA-Tag of the same CPEs. VLAN-Tag: 1 is associated with CPE#1 assigned CPE-ID: 1, VLAN-Tag: 2 with CPE#2 assigned CPE: 2, and VLAN-Tag: 3 with both CPE#3 assigned CPE: 3 and CPE#4 assigned CPE: 4. In other words, the CPE#3 and CPE#4 are defined as belonging to the same group.

In the table T2 provided in the BSE of base station #2, the station-specific identifier CPE-IDs of the subordinate CPEs #5 – #8 are written in association with the group identifiers VLA-Tag of the same CPEs. VLAN-Tag: 1 is associated with CPE#5 assigned CPE-ID: 5, VLAN-Tag: 2 with both CPE#6 assigned CPE: 6 and CPE#7 assigned CPE: 7, and VLAN-Tag: 3 with CPE#8 assigned CPE: 8. In other words, the CPE#6 and CPE#7 are defined as belonging to the same group.

In the embodiment shown in FIG. 1, the CPE#3 and CPE#4 are two customer stations at user A's Tokyo head office and the CPE#6 and CPE#7 are customer stations of the same user A's Nagoya branch office. This embodiment conducts communications control

between user A's Tokyo and Nagoya customer stations and conducts communications control with the Tokyo and Nagoya customer stations kept in constant connection.

The BSEs of the base stations #1 and #2 are provided with communications control capability for controlling wireless communications with the customer stations using the Ethernet frame shown in FIG. 3. They conduct communications control using the MAC address included in the frame as the address of a specific communication terminal device, control communications within customer station groups according to the VLAN-Tag included in the frame, and control the handling of transmission data included in the IP frame.

The ATM-SW and BSE of the base station #1 are connected by VLAN-Tag logical channels. In the table T1 provided in the ATM-SW of the base station #1, the VLAN-Tags are entered in association with information VPI/VCI specifying connection with a path of the ATM trunk network N. For example, VPI/VCI: 2/1 is associated with VLAN-Tag: 3. In other words, communication by VLAN-Tag: 3 is conducted in a constantly connected state through the connection specified by VPI/VCI: 2/1 of the ATM trunk network N.

The ATM-SW and BSE of the base station #2 are connected by VLAN-Tag logical channels. In the table T1 provided in the ATM-SW of the base station #2, the VLAN-Tags are entered in association with information VPI/VCI specifying connection with a path of the ATM trunk network N. For example, VPI/VCI: 2/1 is associated with VLAN-Tag: 2. In other words, communication by VLAN-Tag: 2 is conducted in a constantly connected state through the connection specified by VPI/VCI: 2/1 of the ATM trunk network N.

The ATM-SW of each of base stations #1 and #2 is provided with conversion/control capability for using the contents of its table T1 to convert VPI/VCI to VLAN-Tag and thereby pass data received from the ATM trunk network N through the VLAN logical channels to the BSE, and also to use the content of its table T1 to convert VLAN-Tag to VPI/VCI and thereby send the data received from the BSE through the VLAN logical channel out on the ATM trunk network N.

Owing to the conversion/control capability of ATM-SW, therefore, the group on the base station #1side including CPE#3 and CPE#4 assigned VLAN-Tag: 3 and the group on the base station #2 side including CPE#6 and CPE#7 assigned VLAN-Tag: 2 are constantly connected though the connection of the ATM trunk network N specified by VPI/VCI: 2/1. The customer stations installed at user A's Tokyo head office (i.e., the communication terminal devices under them) and the customer stations installed at uer A's Nagoya branch office (i.e., the communication terminal devices under them) are constantly connected.

In the subscriber wireless access system of the foregoing configuration, if, for example, a subscriber (user A) wants to group the CPE#6 and CPE#7 and sends a request to this effect to the operating center, the operating center SNMP manager M rewrites the MIB Table 2 provided in the BSE of the base station #2 in line with the request. Specifically, the SNMP manager server M connects with the base station #2 through an ATM trunk network N setting connection VPI/VCI: 1/1, uses a setting VLAN-Tag: 500 to access the BSE of the

base station #2, and sets the same VLAN-Tag: 2 for the CPE#6 and CPE#7 in the MIB table 2.

Since, as shown in FIG. 3, the wireless frames of the BSE and CPE include VLAN-Tags, the CPE is notified of the VLAN-Tag set in the MIB table 2 of the BSE in this way by wireless communication between the BSE and the CPE.

If, for example, a subscriber (user A) wants to establish constant connection between the group composed of the CPE#3 and CPE#4 of the base station #1, which have already been grouped by setting the same VLAN-Tag: 3, and a customer station group composed of the CPE#6 and CPE#7 of the base station #2, and sends a request to this effect to the operating center, the operating center SNMP manager server M rewrites the MIB table 1 provided in the ATM-SW of the base station #1 in line with the request.

Specifically, the SNMP manager server M connects with the base station #1 via the setting connection VPI/VCI: 1/1 of the ATM trunk network N, accesses ATM-SW, and in the MIB table T1 sets in association with VLA-Tag: 3 of the CPE#3 and CPE#4 of the base station #1 the same VPI/VCI: 2/1 as set for the CPE#6 and CPE#7 of the base station #2.

The present invention thus enables the setting of CPE groups and the establishment of constant connection between CPEs through the ATM trunk network N by a remote operation from the SNMP manager server M.

When the foregoing table setting is in effect and data are, for instance, transmitted from a communication terminal device under the CPE#3 to a communication terminal device under the CPE#4, the VLAN-Tag included in the transmission frame sent from the CPE#3 to the BSE of the base station #1 transfers the data to the CPE#4 associated with the same VLAN-Tag.

Even under the same base station, therefore, communication terminal devices accommodated under different customer stations (CPEs) can communicate with each other just as if they were connected by the same LAN.

When data are sent from a communication terminal device under the CPE#3 to a communication terminal device under a CPE of the same user accommodated by another base station (base station #2), the data are handed over to the ATM-SW in the base station #1 and, based on the MIB table T1, are sent to the base station #2 through the constant VPI/VCI: 2/1 connection established in the ATM trunk network N. The base station #2, based on the VPI/VCI: 2 and its own MIB table 1, converts the received data to the associated VLAN-Tag: 2 and sends them to the CPE#6 and CPE#7 accommodated by the base station #2.

Customer stations (communication terminal devices) accommodated by different base stations can therefore be constantly connected based on settings.

As explained in the foregoing, the present invention provides a subscriber wireless access system that enables trouble-free constant connection between customer stations accommodated by different base stations through a virtual dedicated line network without trouble and enables simple formation of customer station groups. In addition, the present

invention enables the operations for making and modifying the settings for establishing such constant connections and customer station groups to be centralized and performed remotely.